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ABSTRACT

Designed to serve as a preliminary guide for curriculum development and science instruction in South Carolina, this booklet identifies basic skill objectives in science for grades one through eight. Categories of South Carolina's Basic Skills Assessment Program (BSAP) for science include: (1) science concepts; (2) science process skills; (3) science and technology; and (4) nature of science. Explanations of these objectives are provided in two sections: "Science Objectives across Grades" and "Science Objectives by Grade." The "Across Grades" section identifies each objective's general purpose and illustrates the continuum of concept and skill development at each grade. The "By Grade" section contains a statement and overview of each of the four objectives, a list of specific concepts and skills related to each of the objectives, and examples of the concepts and skills for each objective for grades one through eight. (ML)

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BASIC SKILLS ASSESSMENT PROGRAM

STATE SCIENCE OBJECTIVES
Grades 1-8

The South Carolina Department of Education
An Equal Opportunity Agency
March 1986

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INTRODUCTION

The Education Improvement Act of 1984 established an important educational goal for South Carolina by amending the Basic Skills Assessment Program (BSAP) Act to include science as a basic skill. This act mandated the identification of statewide basic skills objectives in science for grades one through eight with the assessment of those objectives in grades three, six, and eight. In passing the EIA, South Carolina has become one of the few states in the nation to recognize the importance of regularly assessing science as a basic skill. Consequently, the EIA has placed South Carolina at the forefront of science education and assessment.

DEVELOPMENT OF THE SCIENCE OBJECTIVES

To initiate the development of the science objectives that were mandated by the EIA, the South Carolina Department of Education solicited assistance from science educators throughout the state. District superintendents from each of the 92 school districts were asked to recommend elementary and secondary science teachers to serve on an advisory committee. Concurrently, district science curriculum supervisors, as well as science and science education faculty from higher education, were invited to participate. As a result of this process, the Department formed the BSAP Science Committee so that it was representative of the state and reflected all aspects of science education.

During the 1984-85 school year, the science committee met several times to identify the preliminary science objectives. The first charge given to the science committee was the development of a philosophy of science as a basic skill. The consensus of the committee was that a basic science education should produce scientifically literate individuals, students who understand science concepts and processes and are able to use this knowledge in making everyday decisions. Furthermore, the development of students' understanding of the interrelationships between science, technology, and society was considered to be important. By understanding these interrelationships, students should be better prepared to make decisions about the appropriate use of science and technology. Finally, the committee wanted students to understand the nature of science, namely, that science is an on-going process through which science knowledge changes in the light

of new information. Thus, from the perspective of the science committee, a basic science education should prepare individuals to use the knowledge, processes, and products of science in their thinking and daily lives.

It was the opinion of the committee that instruction in science basic skills facilitates the development of logical and creative thinking skills, as well as problem solving skills. In addition to science being a separate basic skill area, science provides the unique opportunity to integrate the basic skill areas of reading, mathematics, and writing during the course of a lesson.

Having addressed the issue of science as a basic skill area, the committee worked on the development of the preliminary BSAP Science Objectives. The committee was guided in this process by the same guidelines that had been established by the State Board of Education for identifying the BSAP objectives in reading, mathematics, and writing. Therefore, the science objectives were developed so that:

- they represent broad outcomes of learning that reflect a continuum of concept and skill development;
- they are basic skills objectives that reflect all levels of difficulty, not minimum competency objectives; and
- they represent measurable basic skills that are cognitive in nature.

Consequently, the BSAP Science Objectives are very similar in nature and scope to the other BSAP objectives.

To develop objectives that would be consistent with the committee's philosophy and also representative of important current directions in science education, the committee reviewed both local and national science program resources. As part of this review, the committee examined science objectives obtained from South Carolina school districts, science objectives developed by other states, and national goals for science education.

During the course of several meetings, the committee identified four preliminary science objectives which reflect major areas of science learning.

Science Concepts:	The student can apply science concepts.
Science Process Skills:	The student can apply science process skills.

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Science and Technology:	The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.
Nature of Science:	The student can demonstrate a comprehension of the nature of science.

Having identified these broad objectives, the committee then determined more specific concepts and skills along with appropriate grade-level examples. These components formed the basis of the grade-level explanation for each objective.

To obtain input from educators, a statewide survey of the preliminary science objectives was conducted during September of 1985. The survey forms were sent to each of South Carolina's 92 school districts and were reviewed by science teachers in grades one through eight. The survey forms were specific to each grade level so that teachers could examine the objectives and explanations that were appropriate for their students. Three additional groups of science educators also participated in this review process: a sample of science teachers in grades nine through twelve, district science curriculum supervisors, and science and science education faculty in higher education institutions.

The results from the survey indicated that science educators at all levels were very supportive of the objectives and their explanations. In general, the educators indicated that all four objectives were important basic skills and that the explanations clearly communicated the overall instructional intent. Furthermore, the results indicated that across all four of the objectives, some of the more specific skills and grade-level examples were unclear. Based on these findings, the committee worked intensively to refine and clarify these skills and examples. Survey respondents were also asked to suggest any additional objectives that were not addressed in the preliminary science objectives. After reviewing the suggested objectives, the committee did not find it necessary to include any additional objectives. The suggested objectives were fairly specific and,

consequently, were already incorporated in the objectives. The decision was made to retain them for future reference as the objectives were more fully defined for testing.

After the objectives and explanations had been revised, the BSAP Science Committee voted unanimously to submit the BSAP Science Objectives to the State Board of Education for approval. Prior to submitting the objectives to the State Board of Education, the objectives were reviewed by the Basic Skills Advisory Commission. The objectives were well-received by the commission which recommended them to the State Board of Education. Subsequently, the State Board reviewed and unanimously approved the objectives on January 8, 1986, and commended the BSAP Science Committee for developing an excellent foundation for science instruction and assessment in South Carolina.

PURPOSE AND USE OF THE BSAP SCIENCE OBJECTIVES

The BSAP Science Objectives, as contained in this booklet, are intended to serve as targets for science instruction in South Carolina. These objectives and the accompanying explanations provide a framework upon which classroom teachers, district curriculum supervisors, and administrators **can begin** to develop curriculum and instructional strategies for a basic science program. Because the testing strategies for the objectives are still being delineated, this booklet should be viewed as **a preliminary guide** for curriculum development and science instruction. The grade-level examples in the objective explanations are included for illustrative purposes only and represent **only a few of the many examples** that may be appropriate for each grade.

The objectives booklet is divided into two sections: Science Objectives Across Grades and Science Objectives By Grade. The first section, Science Objectives Across Grades, illustrates the development of concepts and skills for each objective beginning with grade one and continuing through grade eight. The second section, Science Objectives By Grade, presents all four BSAP Science Objectives and the accompanying explanations for each grade.

SCIENCE OBJECTIVES ACROSS GRADES

The science objectives represent broad outcomes of learning and were developed so that there is a continuum of concept and skill development across grades. In this section, across-grade descriptions and skill charts for the four science objectives are presented. Together, these descriptions and skill charts provide a continuum of concept and skill development; however, **the placement of skills along the continuum is preliminary and, therefore, tentative.** Simpler concepts and skills are presented in the lower grades, and more complex concepts and skills are developed in later grades. By targeting learning on this continuum, students should be able to demonstrate competence with respect to all four objectives by the time they have completed the eighth grade.

In the test development process, each objective will be more fully delineated for instructional and testing purposes. Therefore, some changes may occur in the grade-level emphasis and placement of the skills. Consequently, the objectives and accompanying explanations should be viewed as a framework upon which teachers can begin to direct their science instruction. Further specification of the objectives, including grade-level placement, instructional activities, and sample test questions will be provided in Teaching and Testing Our Basic Skills, Science, Grades 1-8.

SCIENCE CONCEPTS OBJECTIVE, ACROSS-GRADE OVERVIEW

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

The Science Concepts Objective represents student learning related to the basic concepts, laws, and theories of science. The purpose of this objective is to increase students' understanding of, as well as interest in and appreciation for, the natural and physical world in which they live. To foster the understanding of science concepts, the emphasis of this objective is on students' comprehension and application of science knowledge rather than on the recall of science facts. Thus, the intent of this objective is that students develop a foundation of knowledge which can be used in making decisions about science-related problems.

As shown in the skill chart on the next page, this objective includes a continuum of concept development in all science areas and for all grades. The concepts introduced in the first grade are expanded and reinforced in subsequent grades. In earlier grades, concepts are introduced at a relatively simple and concrete level. Students should be able to understand and apply these concepts in familiar contexts. In later grades, the science concepts tend to become more complex and abstract in nature. By applying concepts which were previously learned, students should be able to understand more complex relationships.

SCIENCE CONCEPTS OBJECTIVE, ACROSS-GRADE OVERVIEW

SKILL CHART

Concepts/Skills	Grades 1 2 3 4 5 6 7 8
The student can comprehend and apply basic life science concepts.	
- Characteristics and structures of organisms and differences between organisms	⟷
- Interactions among organisms and interactions between organisms and their environment	⟷
- Changes in organisms	⟷
The student can comprehend and apply basic earth-space science concepts.	
- Composition and structure of the earth, solar system, and universe	⟷
- Interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe	⟷
- Changes in the land, water, atmosphere, solar system, and universe	⟷
The student can comprehend and apply basic physical science concepts.	
- Properties of matter and energy	⟷
- Interactions of matter and energy	⟷
- Changes in matter and energy	⟷

SCIENCE PROCESS SKILLS, OBJECTIVE ACROSS-GRADE OVERVIEW

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

The Science Process Skills Objective targets learning on skills for gathering, interpreting, and using information to solve problems. Today's students are growing up in an age which requires that they learn **how** to understand and use information rather than simply remember information. Consequently, the process skills are important not only as science skills, but also as generic skills which can be widely applied to solve a variety of problems. As students become actively involved in using the process skills, they learn to ask questions, identify problems, develop strategies for investigating possible solutions, and obtain and use information to determine solutions or make decisions. Activities involving the science process skills also provide opportunities for students to apply and integrate other basic skills in reading, mathematics, and writing in a real-life context.

As shown in the skill chart on the next page, this objective includes a continuum of skill development. In the earlier grades the emphasis is on the basic process skills, which involves learning how to collect, organize, and begin to interpret information. In later grades, students apply the basic skills as they learn and use integrated process skills as they design and conduct investigations and experiments to solve problems.

SCIENCE PROCESS SKILLS OBJECTIVE, ACROSS-GRADE OVERVIEW

SKILL CHART

Concepts/Skills	Grades 1 2 3 4 5 6 7 8
The student can apply basic science process skills.	
- Making qualitative observations using the senses	←——————————→
- Making quantitative observations using measuring devices	←——————————→
- Classifying objects, organisms, and events	←——————————→
- Sequencing objects, organisms, and events	←————→
- Locating data in tables and graphs	←————→
- Making inferences based on observations and data	←——————————→
- Making predictions based on observations and data	←——————————→
- Communicating information from a science experience	←——————————→
The student can apply integrated science process skills.	
- Generating questions/formulating problems	←————→
- Identifying existing or needed information for solving a problem	←————→
- Formulating hypotheses	←————→
- Identifying variables	←————→
- Defining variables operationally	←————→
- Formulating/selecting strategies to test hypotheses	←————→
- Interpreting data and drawing conclusions	←————→

SCIENCE AND TECHNOLOGY OBJECTIVE, ACROSS-GRADE OVERVIEW

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

The purpose of the Science and Technology Objective is to increase student understanding of and the ability to apply science knowledge and processes to solve personal and societal problems. As science and technology continue to influence every aspect of our lives, understanding of the interrelationships among science, technology, and society becomes critical to the welfare of the individual and of society. Numerous examples of the importance of science and technology are evident in the production of food, shelter, clothing, medicines, transportation, and various sources of energy. To achieve this objective, the student must understand both the processes and products of technology, and the relationships between science and technology. Students must also be able to analyze the impact of science and technology on themselves, their society, and their environment.

As shown in the skill chart on the next page, the objective includes a continuum of concept and skill development across grades. In the earlier grades, emphasis is on the awareness of technology. Students should recognize that technology is present in their lives and has an effect on them and their immediate environment. In later grades, students should be able to comprehend and analyze relationships between science and technology, that is, the use of science knowledge in the development of technology, as well as the use of technology for furthering science knowledge. Students should also be able to comprehend and analyze the effects of science and technology on themselves, on different societies, and on a variety of environments.

SCIENCE AND TECHNOLOGY OBJECTIVE, ACROSS-GRADE OVERVIEW

SKILL CHART

Concepts/Skills	Grades 1	2	3	4	5	6	7	8
The student can comprehend technology and analyze its relationships to science.								
- Relationship of science to technology	←	—	—	—	—	—	—	→
- Relationship of technology to science				←	—	—	—	→
The student can comprehend and analyze effects of technology on self, society, and the environment.								
- Effects of technology on self and society	←	—	—	—	—	—	—	→
- Effects of technology on the environment and natural resources	←	—	—	—	—	—	—	→

NATURE OF SCIENCE OBJECTIVE, ACROSS-GRADE OVERVIEW

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

The Nature of Science Objective addresses the nature of science knowledge, that is, the body of knowledge which affects the way in which we survive on this planet. From a broad perspective, this objective focuses on understanding the characteristics of science knowledge as a whole, how and why science knowledge is generated, and the factors which affect the use and interpretation of science knowledge.

As shown in the skill chart on the next page, the objective includes a continuum of concept and skill development. In the earlier grades, the emphasis is on facilitating students' understanding of basic characteristics of science knowledge. In later grades, students begin to develop a more comprehensive understanding of the characteristics of science knowledge, how science knowledge is generated, and the personal and societal factors which affect the use and interpretation of science knowledge. Furthermore, consistent with cognitive development of students in the earlier grades, the characteristics of science knowledge focus on students' understanding of their own knowledge. In later grades, the focus shifts to understanding the characteristics of the body of science knowledge and the generation of science knowledge from the context of the scientist.

NATURE OF SCIENCE OBJECTIVE, ACROSS-GRADE OVERVIEW

SKILL CHART

Concepts/Skills	Grades 1	2	3	4	5	6	7	8
The student can comprehend characteristics of science knowledge.								
- Tentative	←	—	—	—	—	—	—	→
- Based on data	←	—	—	—	—	—	—	→
- Includes models						←	—	→
The student can comprehend how science knowledge is generated.								
- Through discoveries motivated by curiosity				←	—	—	—	→
- By combining and applying results from previous studies				←	—	—	—	→
- By repeating investigations						←	—	→
The student can comprehend how the use and interpretation of science knowledge is affected by various factors.								
- Effects of personal perspectives					←	—	—	→
- Effects of societal influences					←	—	—	→

SCIENCE OBJECTIVES BY GRADE

In this section, the four science objectives -- Science Concepts, Science Process Skills, Science and Technology, and Nature of Science -- are presented for each of grades one through eight and are accompanied by the appropriate grade level explanations. Although all four objectives are presented in the same order at each grade level, they should be integrated during instruction.

The descriptor of the objective is presented first and is followed by a statement of the objective and the explanation of the objective. The descriptor is a "short-hand" notation for the objective. The "Explanation" of the objective for each grade provides an overview of the objective, a list of more specific concepts and skills which comprise the objective, and examples of these concepts and skills. The examples, found in parentheses, represent only **one of the many grade-level examples** that are appropriate and are intended to be illustrative, not exhaustive. For example, in sixth grade, the example for "interactions among organisms and interactions among organisms and their environment" focuses on instinctive and learned behavior as examples of interaction among animals. Aside from these behavioral interactions, there are also other interactions among organisms, as well as interactions among organisms and their environment. There are still many other examples which also may be appropriate. Therefore, the examples provided should be the basis for selecting other examples of appropriate concepts and skills.

SCIENCE OBJECTIVES: GRADE ONE

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in life science, earth-space science, and physical science. The concepts should be related to experiences, events, and surroundings which are familiar to students. More specifically, in the first grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic life science concepts which may include:

- characteristics and structures of organisms and differences among organisms (e.g., characteristics of living and non-living things and basic characteristics of plants and animals);
- interactions among organisms and interactions among organisms and their environments (e.g., relationships among the needs of plants and animals and their habitats); and
- changes in organisms (e.g., changes in plants and animals related to growth).

The student can comprehend and apply basic earth-space science concepts which may include:

- composition and structure of the earth, solar system, and universe (e.g., different land forms such as mountains, lakes, and rivers and properties of air, rocks, soil, and water);
- interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe (e.g., relationships involving seasons and temperatures); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., changes related to weather and seasons).

The student can comprehend and apply basic physical science concepts which may include:

- properties of matter and energy (e.g., the properties of matter such as color, weight, size, and texture and the characteristics of energy such as hot-cold, loud-soft, and light-dark);
- interactions of matter and energy (e.g., forces on objects such as pushing and pulling); and
- changes in matter and energy (e.g., heat melting an ice cube).

SCIENCE OBJECTIVES: GRADE ONE

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply science process skills in a science activity. In the first grade, the skills are more basic and help the student learn about the world through observing, locating data, measuring, classifying, sequencing, inferring, and communicating. In the upper grades, these basic skills become integrated in that students may use several of these skills to conduct an investigation. More specifically, in the first grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making observations using one or more of the five senses to determine the properties of an object (e.g., examining a shape such as a sphere or cube and finding examples of them such as a ball or block);
- using measuring devices to collect data in non-standard units (e.g., determining the length of a desk using the length of a pencil as a unit of measure);
- classifying objects, organisms, and events using one or two characteristics (e.g., classifying leaves by size);
- sequencing objects, organisms, and events (e.g., sequencing students by height);
- locating data in tables and graphs (e.g., locating information in simple picture graphs and bar graphs);
- making simple inferences based on observations and data (e.g., given pictures of adult and young animals, inferring which babies belong with which parents); and
- communicating orally information about a science experience (e.g., describing the size, smell, feel, color, or sounds of an animal).

SCIENCE OBJECTIVES: GRADE ONE

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend the nature of technology and its relationship to science. In the earlier grades, students begin to understand technology by developing an awareness of familiar technological products. They also begin to develop an awareness of the effects of technology on themselves, people, and the environment. By understanding these relationships, students should be better prepared to live in a society which is rapidly changing because of advances in science and technology. More specifically, in the first grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- an awareness of technology (e.g., an awareness that bicycles and cars are produced by technology).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., an awareness that bicycles and cars affect our ability to easily transport ourselves); and

- the effects of technology on the environment and natural resources (e.g., an awareness that food wrappers and soft drink containers produced by technology can result in litter).

SCIENCE OBJECTIVES: GRADE ONE

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. Through a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the first grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that it is subject to change as more information is obtained and is better understood (e.g., the student begins to recognize that his/her knowledge of animals changes as he/she acquires more information about different types of animals); and

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g., in an activity involving magnets, the student begins to recognize that observations are needed to answer questions such as "What types of materials do magnets attract?").

SCIENCE OBJECTIVES: GRADE TWO

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in life science, earth-space science, and physical science. The concepts should be related to experiences, events, and surroundings which are familiar to students. More specifically, in the second grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic life science concepts which may include:

- characteristics and structures of organisms and differences among organisms (e.g., characteristics of different types of animals such as mammals, fish, insects, and reptiles);
- interactions among organisms and interactions among organisms and their environments (e.g., relationships such as a food chain); and
- changes in organisms (e.g., changes in plants such as the germination of seeds and the growth of seedlings into mature plants).

The student can comprehend and apply basic earth-space science concepts which may include:

- composition and structure of the earth, solar system, and universe (e.g., the composition of different types of soil such as clay and sand);
- interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe (e.g., regional differences in temperature and rainfall that result in different types of environments such as deserts or rain forests); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., changes in the earth's surface due to water and wind erosion).

The student can comprehend and apply basic physical science concepts which may include:

- properties of matter and energy (e.g., physical properties of different forms of matter such as solids, liquids, and gases);
- interactions of matter and energy (e.g., the effects of forces on motion such as stopping or starting and speeding up or slowing down); and
- changes in matter and energy (e.g., the body changes food into energy).

SCIENCE OBJECTIVES: GRADE TWO

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply science process skills in a science activity. In the second grade, the skills are more basic and help the student learn about the world through observing, locating data, measuring, classifying, sequencing, inferring, and communicating. In the upper grades, these basic skills become integrated in that students may use several of these skills to conduct an investigation. More specifically, in the second grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making observations using the five senses to determine the properties of an object (e.g., observing different fabrics for color, texture, and pattern);
- using measuring devices to collect data in standard metric units (e.g., using a metric ruler to determine the length of a rectangle);
- classifying objects, organisms, and events using two or three characteristics (e.g., classifying liquids by color and odor);
- sequencing objects, organisms, and events (e.g., sequencing leaves from largest to smallest);
- locating data in tables and graphs (e.g., locating information in simple tables, picture graphs, and bar graphs);
- making simple inferences based on observations and data (e.g., given sets of pictures showing children in different types of clothing such as overcoats, raincoats, and shorts, inferring what the weather is like); and
- communicating information about a science experience orally and in a simple table, picture graph, or bar graph (e.g., describing the types of plants and animals in the school yard and showing the number of different types of plants and animals in a simple table, picture graph, or bar graph).

SCIENCE OBJECTIVES: GRADE TWO

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend the nature of technology and its relationship to science. In the earlier grades, students begin to understand technology by developing an awareness of familiar technological products. They also begin to develop an awareness of the effects of technology on themselves, people, and the environment. By understanding these relationships, students should be better prepared to live in a society which is rapidly changing because of advances in science and technology. More specifically, in the second grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- an awareness of technology (e.g., an awareness that radios and televisions are produced by technology).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., an awareness that refrigerators affect our ability to store foods); and

- the effects of technology on the environment and natural resources (e.g., an awareness that resources such as aluminum can be conserved through the technology of recycling).

SCIENCE OBJECTIVES: GRADE TWO

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. Through a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the second grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that is subject to change as more information is obtained and is better understood (e.g., the student begins to recognize that his/her knowledge about how to grow plants changes as he/she acquires more information about different types of plants); and

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g., in an investigation of seeds, the student begins to recognize that observations and measurements are needed to answer questions such as "What is the best temperature at which a seed begins to grow?").

SCIENCE OBJECTIVES: GRADE THREE

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in life science, earth-space science, and physical science. The concepts should be related to experiences, events, and surroundings which are familiar to students. More specifically, in the third grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic life science concepts which may include:

- characteristics and structures of organisms and differences among organisms (e.g., external structures of plants and their functions such as leaves which make food and roots which anchor the plant and absorb water and minerals);
- interactions among organisms and interactions among organisms and their environments (e.g., the interaction of populations of organisms that live within a pond community); and
- changes in organisms (e.g., changes in animals related to their individual life cycles such as the metamorphosis of a caterpillar into a butterfly).

The student can comprehend and apply basic earth-space science concepts which may include:

- composition and structure of the earth, solar system, and universe (e.g., the composition of soil layers such as topsoil and subsoil in an environment);
- interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe (e.g., relationships of water to the atmosphere such as fog, clouds, and precipitation); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., changes in the land due to natural forces such as the formation of soil as a result of the weathering of rocks).

The student can comprehend and apply basic physical science concepts which may include:

- properties of matter and energy (e.g., properties of simple machines such as a hammer or scissors as related to the work that they do or the energy that they use);
- interactions of matter and energy (e.g., different materials such as metal, wood, and plastic conduct heat differently); and
- changes in matter and energy (e.g., changes in the state of matter by melting, boiling, evaporating, or freezing).

SCIENCE OBJECTIVES: GRADE THREE

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply science process skills in a science activity. In the third grade, the skills are more basic and help the student learn about the world through observing, locating data, making simple interpretations of data, measuring, classifying, sequencing, inferring, predicting, and communicating. In the upper grades, these basic skills become integrated in that students may use several of these skills to conduct an investigation. More specifically, in the third grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making observations using the five senses to determine the characteristics of an event (e.g., observing changes caused by heating, freezing, and boiling);
- using measuring devices to collect data (e.g., using a measuring device such as a thermometer to measure the temperature inside and outside the classroom over a period of time);
- classifying objects, organisms, and events using two or three characteristics (e.g., classifying students by gender, hair color, and month of birth);
- sequencing objects, organisms, and events (e.g., sequencing the stages of the life cycle of a butterfly such as egg, larva, pupa, and adult);
- locating data in tables and graphs and making simple interpretations of data (e.g., locating and interpreting information in simple tables, picture graphs, and bar graphs);
- making simple inferences and predictions based on observations and data (e.g., after measuring the temperature at various hours of the day, inferring the reason for changes in temperature and predicting the temperature at a particular time of the next day); and
- communicating information about a science experience orally and in writing (e.g., describing observations and organizing data into simple tables, picture graphs, bar graphs, etc.).

SCIENCE OBJECTIVES: GRADE THREE

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend the nature of technology and its relationship to science. In the earlier grades, students begin to understand technology by developing an awareness of familiar technological products. They also begin to develop an awareness of the effects of technology on themselves, people, and the environment. By understanding these relationships, students should be better prepared to live in a society which is rapidly changing because of advances in science and technology. More specifically, in the third grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- an awareness of technology (e.g., an awareness that airplanes and the space shuttle are produced by technology).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., an awareness that telephones, radios, and televisions affect our ability to communicate); and

- the effects of technology on the environment and natural resources (e.g., an awareness that an increase in the use of automobiles can result in air pollution).

SCIENCE OBJECTIVES: GRADE THREE

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. Through a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the third grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that it is subject to change as more information is obtained and is better understood (e.g., the student begins to recognize that his/her knowledge about weather prediction changes as he/she acquires more information about different types of weather); and

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g., in an investigation involving floating and sinking objects, the student begins to recognize that observations and measurements are needed to answer questions such as "What kinds of objects float?").

SCIENCE OBJECTIVES: GRADE FOUR

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in life science, earth-space science, and physical science. The concepts should be developed through student involvement with the environment. More specifically, in the fourth grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic life science concepts which may include:

- characteristics and structures of organisms and differences among organisms (e.g., characteristics and functions of body systems in animals such as the circulatory system);
- interactions among organisms and interactions among organisms and their environments (e.g., food webs of plant and animal populations within a community); and
- changes in organisms (e.g., relationships between the type of habitat and the physical adaptations of different organisms to that habitat such as protective coloration).

The student can comprehend and apply basic earth-space science concepts which may include:

- composition and structure of the earth, solar system, and universe (e.g., properties of rocks such as color, texture, shape);
- interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe (e.g., relationships of wind, temperature, and barometric pressure to weather); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., natural changes in the land resulting in deltas and dunes).

The student can comprehend and apply basic physical science concepts which may include:

- properties of matter and energy (e.g., properties of forms of energy such as heat, light, and sound);
- interactions of matter and energy (e.g., effects of friction on objects such as rubbing both hands together to produce heat); and
- changes in matter and energy (e.g., chemical changes in matter such as iron rusting).

SCIENCE OBJECTIVES: GRADE FOUR

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply basic and integrated process skills in a science investigation. In the fourth grade, the basic process skills help the student learn about the world through observing, classifying, sequencing, inferring, predicting, and communicating. These skills are more complex than those at earlier grades in that students are expected to apply these skills in different contexts. In the fourth grade, students may integrate several basic skills when generating questions, formulating simple hypotheses, identifying variables, interpreting data, and drawing conclusions during a science investigation. More specifically, in the fourth grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making qualitative and quantitative observations (e.g., making qualitative observations such as observing the shape and color of clouds during a thunderstorm and making quantitative observations such as using a rain gauge to measure rainfall);
- classifying objects, organisms, and events using three or four characteristics (e.g., classifying leaves by size, shape, color, and vein patterns);
- sequencing objects, organisms, and events (e.g., sequencing objects by their masses);
- making inferences and predictions based on observations and data (e.g., predicting a change in water temperature when an ice cube is placed in a glass of tap water and inferring the reason for the change); and
- communicating information from a science experience orally and in writing (e.g., describing observations and organizing data into tables, picture graphs, bar graphs, histograms, etc.).

SCIENCE OBJECTIVES: GRADE FOUR

SCIENCE PROCESS SKILLS (continued)

The student can comprehend and apply integrated science process skills such as:

- generating questions that can be investigated (e.g., given a situation in which several bean plants have grown to different heights, asking questions such as "Why did the plants grow to different heights?");
- formulating simple hypotheses (e.g., guessing, based on prior experiences, that "The amount of water affected the height of the plants.");
- identifying variables (e.g., identifying the amount of water as a factor which may have caused the plants to grow); and
- interpreting data and drawing conclusions (e.g., interpreting data presented in simple tables, picture graphs, bar graphs, histograms, line graphs, etc. and drawing conclusions from observations and data).

SCIENCE OBJECTIVES: GRADE FOUR

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend and analyze the relationships between science and technology and the effects of science and technology on the community. By developing an understanding of the nature of technology through analyzing these relationships, students should be better prepared to live in a rapidly changing scientifically and technologically oriented society. More specifically, in the fourth grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- the relationship of science to technology (e.g., the use of scientific knowledge about electricity in the development of electrical appliances); and

- the relationship of technology to science (e.g., the use of technology such as electric lights in greenhouses to study the effect of increased amounts of light on plants).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., the emergence of new careers as a result of computer technology); and

- the effects of technology on the environment and natural resources (e.g., conservation of farm lands through the use of crop rotation or irrigation systems).

SCIENCE OBJECTIVES: GRADE FOUR

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. From a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the fourth grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that it is subject to change as more information is obtained and is better understood (e.g., the student recognizes that his/her knowledge about seeds changes as he/she acquires more information about conditions that affect seed germination); and

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g, in an investigation involving changes in objects, the student recognizes that data are needed to answer questions such as "What causes a nail to rust?").

The student can comprehend that science knowledge is generated through:

- curiosity which motivates discoveries (e.g., the student recognizes that curiosity motivates scientists to investigate properties of matter); and

- combining and applying results from previous studies (e.g., the student recognizes that his/her new knowledge about the properties of liquids is acquired by combining prior knowledge with results from current investigations).

SCIENCE OBJECTIVES: GRADE FIVE

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in life science, earth-space science, and physical science. The concepts should be developed through student involvement with the environment. More specifically, in the fifth grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic life science concepts which may include:

- characteristics and structures of organisms and differences among organisms (e.g., structures and functions of major organs or parts of body systems such as the heart and blood vessels of the circulatory system);
- interactions among organisms and interactions among organisms and their environments (e.g., relationships among plants, animals and environmental factors such as light, water, and temperature in an ecosystem); and
- changes in organisms (e.g., growth and reproduction in plants).

The student can comprehend and apply basic earth-space science concepts which may include:

- composition and structure of the earth, solar system, and universe (e.g., properties of minerals such as color and hardness);
- interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe (e.g., effects related to the tilt of earth such as differences in seasons between the northern and southern hemispheres); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., changes in the earth's surface due to earthquakes and volcanoes).

The student can comprehend and apply basic physical science concepts which may include:

- properties of matter and energy (e.g., properties of mixtures and differences between mixtures and solutions);
- interactions of matter and energy (e.g., use of a compound machine such as a bicycle or motor to make work easier); and
- changes in matter and energy (e.g., chemical/physical changes such as crystal formation).

SCIENCE OBJECTIVES: GRADE FIVE

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply basic and integrated process skills in a science investigation. In the fifth grade, the basic process skills help the student learn about the world through observing, classifying, inferring, predicting, and communicating. These skills are more complex than those at earlier grades in that students are expected to apply these skills in different contexts. In the fifth grade, students may integrate several basic skills when generating questions, formulating simple hypotheses, identifying variables, defining variables, interpreting data, and drawing conclusions during a science investigation. More specifically, in the fifth grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making qualitative and quantitative observations (e.g., making qualitative observations such as observing the size and color of beans and making quantitative observations such as using a scale to weigh beans);

- classifying objects, organisms, and events using several characteristics (e.g., classifying plants on the basis of several attributes such as leaf shape, stem shape, fruit type, flower type, and flower color);

- making inferences and predictions based on observations and data (e.g., predicting how high a ball will bounce when dropped from different heights and inferring why the heights of the bounces were different); and

- communicating information from a science experience orally or in writing (e.g., describing a science investigation and organizing data into tables, bar graphs, histograms, simple line graphs, etc.).

SCIENCE OBJECTIVES: GRADE FIVE

SCIENCE PROCESS SKILLS (continued)

The student can comprehend and apply integrated science process skills such as:

- generating questions that can be investigated (e.g., given a situation in which a sugar cube is placed in cold and hot tea, asking questions such as "What affects the rate at which the sugar cube dissolves?");
- formulating simple hypotheses (e.g., guessing, based on prior experiences, that "Temperature affects the rate of dissolving.");
- identifying variables (e.g., identifying water temperature as a factor which affects dissolving rate);
- defining variables in observable or measurable terms (e.g., determining ways to observe or measure dissolving rate and temperature); and
- interpreting data and drawing conclusions (e.g., interpreting data presented in tables, bar graphs, histograms, simple line graphs, etc. and drawing conclusions from observations and data).

SCIENCE OBJECTIVES: GRADE FIVE

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend and analyze the relationships between science and technology and the regional, national and international effects of science and technology. By developing an understanding of the nature of technology through analyzing these relationships, students should be better prepared to live in a rapidly changing scientifically and technologically oriented society. More specifically, in the fifth grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- the relationship of science to technology (e.g., the use of scientific knowledge about observations of weather in the development of weather instruments); and

- the relationship of technology to science (e.g., the use of technology such as microscopes to improve scientific knowledge about diseases).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., the simplification of jobs as a result of industrial machines); and

- the effects of technology on the environment and natural resources (e.g., beneficial and harmful effects on other living organisms in an ecosystem when weed killers are used to control weeds).

SCIENCE OBJECTIVES: GRADE FIVE

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. Through a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the fifth grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that it is subject to change as more information is obtained and is better understood (e.g., the student recognizes that his/her knowledge about plants changes as he/she acquires more information about plant reproduction); and

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g., in an investigation involving plants, the student recognizes that data are needed to answer questions such as "How do plants respond to different types of light?").

The student can comprehend that science knowledge is generated through:

- curiosity which motivates discoveries (e.g., the student recognizes that curiosity motivated scientists to investigate properties of energy); and

- combining and applying results from previous studies (e.g., the student recognizes that his/her new knowledge about light is acquired by combining prior knowledge with results from current investigations).

The student can comprehend how the use and interpretation of science knowledge is affected by factors such as:

- personal perspectives (e.g., in a discussion on personal health, the student recognizes that a person's choice of whether or not to smoke tobacco is affected by his/her personal perspectives); and

- societal influences (e.g., in a discussion on natural resources, the student recognizes that the use of wilderness for recreational and commercial purposes is affected by societal influences).

SCIENCE OBJECTIVES: GRADE SIX

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in life science, earth-space science, and physical science. The concepts should be developed through student involvement with the environment. More specifically, in the sixth grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic life science concepts which may include:

- characteristics and structures of organisms and differences among organisms (e.g., plant and animal classification systems as models for organizing and identifying organisms);
- interactions among organisms and interactions among organisms and their environments (e.g., instinctive and learned behavioral interactions among animals); and
- changes in organisms (e.g., adaptations or the extinction of plants and animals as a result of environmental factors).

The student can comprehend and apply basic earth-space science concepts which may include:

- composition and structure of the earth, solar system, and universe (e.g., the composition of planets in the solar system as determined from recent space explorations);
- interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe (e.g., causes and effects of space phenomena such as lunar and solar eclipses, solar winds, sunspots, and Aurora Borealis); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., changes in the universe such as expanding galaxies and star burnout).

The student can comprehend and apply basic physical science concepts which may include:

- properties of matter and energy (e.g., characteristics of magnetism and electricity);
- interactions of matter and energy (e.g., relationships between electricity and the electric motor, telegraph, or doorbell); and
- changes in matter and energy (e.g., chemical changes such as combining baking soda with vinegar to produce carbon dioxide).

SCIENCE OBJECTIVES: GRADE SIX

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply basic and integrated process skills in a science investigation. In the sixth grade, the basic process skills help the student learn about the world through observing, classifying, inferring, predicting, and communicating. These skills are more complex than those at earlier grades in that students are expected to apply these skills in different contexts. In the sixth grade, students may integrate several basic skills when formulating simple problems, formulating simple hypotheses, identifying variables, defining variables, identifying and selecting strategies, interpreting data, and drawing conclusions during a science investigation. More specifically, in the sixth grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making qualitative and quantitative observations (e.g., observing characteristics of birds such as "birds have different types of beaks" and using a measuring device such as a metric measuring cup to determine the volume of a liquid);

- classifying the same group of objects, organisms, or events using several characteristics or properties (e.g., classifying birds on the basis of several attributes such as the types of beaks, food sources, feet, and habitats);

- making inferences and predictions based on observations and data (e.g., inferring why beaks of birds are different based on information about their eating habits and predicting which types of birds--cardinals or hummingbirds--will go to each of two feeders, one with seed and one with sugar water); and

- communicating information from a science experience (e.g., describing a science investigation which includes procedures, observations, and conclusions, and organizing data into tables, bar graphs, histograms, line graphs, etc.)

SCIENCE OBJECTIVES: GRADE SIX

SCIENCE PROCESS SKILLS (continued)

The student can comprehend and apply integrated science process skills such as:

- formulating simple problems (e.g., given a situation in which the student observes several different pendulums, developing a problem statement such as "What affects the rate of the pendulum swing?");
- identifying existing or needed information for solving a problem (e.g., obtaining information about factors which affect the rate of the pendulum swing);
- formulating simple hypotheses (e.g., hypothesizing that "The length of the string affects the rate of the pendulum swing.");
- identifying variables (e.g., identifying the string length as the manipulated variable, the rate of pendulum swing as the responding variable, and the pendulum weight as a variable to control);
- defining variables in observable or measurable terms (e.g., defining the rate of the pendulum swing as the number of swings per minute);
- identifying and selecting appropriate strategies to test hypotheses or solve problems (e.g., identifying several strategies and selecting the most appropriate strategy to test the effect of the string length on pendulum swings per minute); and
- interpreting data and drawing conclusions (e.g., interpreting the relationships between variables presented in tables and graphs and drawing conclusions about these relationships).

SCIENCE OBJECTIVES: GRADE SIX

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend and analyze the relationships between science and technology and the regional, national, and international effects of science and technology. By developing an understanding of the nature of technology through analyzing these relationships, students should be better prepared to live in a rapidly changing scientifically and technologically oriented society. More specifically, in the sixth grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- the relationship of science to technology (e.g., the use of scientific knowledge about refraction of light in the development of lenses); and
- the relationship of technology to science (e.g., the use of technology such as telescopes to gather information about the solar system).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., new and useful consumer products developed as a result of space technology); and
- the effects of technology on the environment and natural resources (e.g., acid rain resulting from gaseous wastes released into the air).

SCIENCE OBJECTIVES: GRADE SIX

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. Through a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the sixth grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that it is subject to change as more information is obtained and is better understood (e.g., the student recognizes that his/her knowledge about a tadpole or caterpillar changes as its metamorphosis is observed);

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g., in an investigation involving the movement of a pendulum, the student recognizes that data are needed to answer questions such as "How does the length of the string affect the movement of the pendulum?"); and

- science knowledge is often represented by both conceptual and physical models which represent the best estimate of reality and can be used to understand phenomena and answer questions (e.g., the student recognizes that the sun-centered model of the solar system can be used to explain and answer questions about certain characteristics of planets in the solar system).

The student can comprehend that science knowledge is generated through:

- curiosity which motivates discoveries (e.g., the student recog that curiosity motivates scientists to investigate distant stars),

- combining and applying results from previous studies (e.g., the student recognizes that new knowledge about the solar system is generated when scientists integrate prior knowledge with results from current investigations involving the planets); and

- repeating investigations under similar conditions and obtaining similar results, thereby, establishing the credibility of the results (e.g., through repeated investigations involving the effect of string length on the rate of the swing of a pendulum the student recognizes that similar results make the findings more credible).

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SCIENCE OBJECTIVES: GRADE SIX

NATURE OF SCIENCE (continued)

The student can comprehend how the use and interpretation of science knowledge is affected by factors such as:

- personal perspectives (e.g., the student recognizes that scientists may disagree on issues such as the use of animals for experimental purposes because of their personal perspectives); and

- societal influences (e.g., in a discussion on endangered species, the student recognizes that protection of animals such as whales is affected by societal influences).

SCIENCE OBJECTIVES: GRADE SEVEN

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in life science with those in earth-space science and physical science. The concepts should be developed through student involvement with the environment. More specifically, in the seventh grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic life science concepts which may include:

- characteristics and structures of organisms and diversity of organisms (e.g., cellular organelles in plants and animals; similarities and differences between plant and animal cells);
- interactions among organisms and interactions among organisms and their environments (e.g., communication behaviors of social insects such as the communications among bees in locating food); and
- changes in organisms (e.g., sexual and asexual reproduction in animals and plants).

The student can comprehend and apply basic earth-space science concepts related to life science which may include:

- the composition and structure of earth, solar system, and universe (e.g., the composition of soil as related to plant growth);
- interactions among land, water, and atmosphere and interactions among the earth, solar system, and universe (e.g., relationships of climate and soil type to plant growth in different regions of the world); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., the effects of an ice age on animals and plants).

The student can comprehend and apply basic physical science concepts related to life science which may include:

- properties of matter and energy (e.g., basic elements and compounds such as carbon, nitrogen, nucleic acids, proteins, sugars, and fats in living things);
- interactions of matter and energy (e.g., energy flow through an ecosystem and diffusion and osmosis); and
- changes in matter and energy (e.g., chemical reactions such as respiration and photosynthesis).

SCIENCE OBJECTIVES: GRADE SEVEN

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply basic and integrated process skills in designing and conducting investigations to solve problems. In the seventh grade, the basic process skills help the student learn about the world through observing, classifying, inferring, predicting, and communicating. These skills are more complex than those at earlier grades in that students are expected to apply these skills in different contexts. In the seventh grade, students may integrate several basic skills when formulating simple problems, identifying existing or needed information, formulating hypotheses, identifying variables, operationally defining variables, formulating and selecting strategies, interpreting data, and drawing conclusions during a science investigation. More specifically, in the seventh grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making qualitative and quantitative observations (e.g., observing physical changes in a person during physical activity and using fingers to measure pulse rate before and after running in place);

- using multi-stage classification systems to classify objects, organisms, and events (e.g., classifying organisms using existing classification systems such as classifying an animal as to Kingdom, Phylum, and Class);

- making inferences and predictions based on observations and data (e.g., predicting the behavior of both warm-blooded and cold-blooded animals based on temperature changes and inferring the reasons for the different behaviors); and

- communicating information from a science experience (e.g., selecting and constructing the appropriate types of tables and graphs to represent data collected in a science experiment and writing a lab report which includes a statement of the problem, a hypothesis, procedures, results, and conclusions).

SCIENCE OBJECTIVES: GRADE SEVEN

SCIENCE PROCESS SKILLS (continued)

The student can comprehend and apply integrated science process skills such as:

- formulating simple problems (e.g., given a situation where some tomato plants have wilted, developing a problem statement such as "What caused the tomato plants to wilt?");
- identifying existing or needed information for solving a problem (e.g., obtaining information about the water requirements of tomato plants to determine variables which affect wilting in tomato plants);
- formulating hypotheses (e.g., hypothesizing that "The amount of water the tomato plants received caused them to wilt.");
- identifying variables (e.g., identifying the amount of water that the plants received as the manipulated variable, the wilting of the tomato plants as the responding variable, and light and soil type as the controlled variables);
- defining variables operationally (e.g., defining the amount of water a plant receives in milliliters of water and defining a wilted tomato plant as one in which the leaves are limp or hang vertically);
- formulating and selecting appropriate strategies to test hypotheses or solve problems (e.g., formulating several strategies and then selecting the most appropriate to test hypotheses about wilting in tomato plants); and
- interpreting data and drawing conclusions (e.g., interpreting the relationship between wilting in the tomato plant and the amount of water the plant received and developing a conclusion about this relationship).

SCIENCE OBJECTIVES: GRADE SEVEN

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend and analyze the relationships between science and technology and the regional, national and international effects of science and technology. By developing an understanding of these relationships, students should be better prepared to live in a rapidly changing scientifically and technologically oriented society. More specifically, in the seventh grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- the relationship of science to technology (e.g., the use of scientific knowledge about sound waves in the development of stethoscopes); and

- the relationship of technology to science (e.g., the use of technology such as electron microscopes to gather information about viruses).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., prolonging life through the use of technology developed for organ transplants); and

- the effects of technology on the environment and natural resources (e.g., increased crop yield through application of genetic research in plants).

SCIENCE OBJECTIVES: GRADE SEVEN

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. Through a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the seventh grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that it is subject to change as more information is obtained and is better understood (e.g., the student recognizes that some science knowledge about the treatment of diseases may change or become invalid as new knowledge is discovered);

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g., in an investigation involving plant growth, the student recognizes that data such as temperature and day length are needed to answer questions such as "What are the optimal conditions for growing tomatoes?"); and

- science knowledge is often represented by both conceptual and physical models which represent the best estimate of reality and can be used to understand phenomena and answer questions (e.g., the student recognizes that a model of an ecosystem can be used to explain and answer questions about some of the relationships among populations).

The student can comprehend that science knowledge is generated through:

- curiosity which motivates discoveries (e.g., the student recognizes that curiosity motivates scientists to investigate deep sea life);

- combining and applying results from previous studies (e.g., the student recognizes that new knowledge about heredity is generated when scientists integrate prior knowledge with results from current investigations involving bio-engineering); and

- repeating investigations under similar conditions and obtaining similar results, thereby, establishing the credibility of the results (e.g., through the repeated investigations involving the effect of fertilizer on plant growth the student recognizes that similar results make the findings more credible).

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SCIENCE OBJECTIVES: GRADE SEVEN

NATURE OF SCIENCE (continued)

The student can comprehend how the use and interpretation of science knowledge is affected by factors such as:

- personal perspectives (e.g., the student recognizes that scientists may disagree on issues such as the use of genetic engineering because of their personal perspectives); and

- societal influences (e.g., in a discussion on genetic engineering, the student recognizes that the use of cloning is affected by societal influences).

SCIENCE OBJECTIVES: GRADE EIGHT

SCIENCE CONCEPTS

OBJECTIVE: The student can apply science concepts.

Explanation: The student can comprehend and apply basic science concepts. These basic science concepts such as characteristics, properties, structures, composition, interactions, and change serve as themes which interrelate concepts in earth-space science with those in life science and physical science. The concepts should be developed through student involvement with the environment. More specifically, in the eighth grade, the student can learn and use skills involving concepts such as the following.

The student can comprehend and apply basic earth-space science concepts which may include:

- the composition and structure of the earth, solar system, and universe (e.g., the composition and structure of land forms, bodies of water, the atmosphere, and the solar system);
- interactions among land, water, and the atmosphere and interactions among the earth, solar system, and universe (e.g., interactions resulting in ocean waves, tides, and currents); and
- changes in the land, water, atmosphere, solar system, and universe (e.g., changes in the earth's surface as a result of plate tectonics).

The student can comprehend and apply basic life science concepts related to earth-space science which may include:

- characteristics and structures of organisms and diversity of organisms (e.g., diversity of organisms in different geologic periods as reflected in the fossil record);
- interactions among organisms and their environments (e.g., the formation of fossil fuels); and
- changes in organisms or ecosystems related to changes in land forms, water, weather, and climate (e.g., succession of plants due to physical changes in soil over time and extinction of organisms resulting from phenomena such as an ice age).

The student can comprehend and apply basic physical science concepts related to earth-space science which may include:

- properties, composition, and structure of matter and energy (e.g., atomic and molecular structure of minerals);
- interactions of matter and energy (e.g., rock cycle, water cycle, waves, atmospheric pressure, and heat transfer); and
- changes in matter and energy (e.g., changes in the earth's surface resulting from weathering and erosion).

SCIENCE OBJECTIVES: GRADE EIGHT

SCIENCE PROCESS SKILLS

OBJECTIVE: The student can apply science process skills.

Explanation: The student can comprehend and apply basic and integrated process skills in designing and conducting investigations to solve problems. In the eighth grade, the basic process skills help the student learn about the world through observing, classifying, inferring, predicting, and communicating. These skills are more complex than those at earlier grades in that students are expected to apply these skills in different contexts. In the eighth grade, students may integrate several basic skills when formulating problems, identifying existing or needed information, formulating hypotheses, identifying variables, operationally defining variables, formulating and selecting appropriate strategies, interpreting data, and drawing conclusions during a science investigation. More specifically, in the eighth grade, the student can learn skills such as the following.

The student can comprehend and apply basic science process skills such as:

- making qualitative and quantitative observations (e.g., observing the crystalline and non-crystalline structure of rocks and using water displacement to measure the density of different rocks);

- classifying objects, organisms, and events based on properties that are not immediately apparent but that are derived through experiments or observations (e.g., classifying minerals based on luster, hardness, streak, color, and pattern);

- making inferences and predictions based on observations and data (e.g., inferring the water holding capacities of various types of soils and predicting the soil permeability of each); and

- communicating information from a science experience (e.g., selecting and constructing the appropriate types of tables and graphs to represent data collected in a science experiment and writing a lab report that includes a statement of the problem, a hypothesis, procedures, results, and conclusions).

SCIENCE OBJECTIVES: GRADE EIGHT

SCIENCE PROCESS SKILLS (continued)

The student can comprehend and apply integrated science process skills such as:

- formulating problems (e.g., given a situation in which some soils are more permeable to water than others, developing a problem statement such as "What affects soil permeability?);
- identifying existing or needed information for solving a problem (e.g., obtaining information from various resources about soil characteristics to determine variables which affect soil permeability);
- formulating hypotheses (e.g., hypothesizing that "Soil texture affects soil permeability.");
- identifying variables (e.g., identifying 'soil texture as the manipulated variable, rate of soil permeability as the responding variable, and the amount of water and the compactness of the soil as controlled variables);
- defining variables operationally (e.g., defining soil permeability as the amount of time it takes water to travel through one cup of soil);
- formulating and selecting appropriate strategies to test hypotheses, control variables, or solve problems (e.g., formulating several strategies and then selecting the most appropriate to test hypotheses about soil permeability); and
- interpreting data and drawing conclusions (e.g., interpreting the relationship between soil permeability and soil texture and developing a conclusion about this relationship).

SCIENCE OBJECTIVES: GRADE EIGHT

SCIENCE AND TECHNOLOGY

OBJECTIVE: The student can analyze the relationships between science and technology, as well as the relationships of science and technology to self, society, and the environment.

Explanation: The student can comprehend and analyze the relationships between science and technology and the regional, national, and international effects. By developing an understanding of these relationships, students should be better prepared to live in a rapidly changing scientifically and technologically oriented society. More specifically, in the eighth grade, the student can learn skills such as the following.

The student can comprehend technology and analyze its relationship to science which may include:

- the relationship of science to technology (e.g., the use of scientific knowledge about light in the development of cameras and telescopes); and

- the relationship of technology to science (e.g., the use of technology such as cameras to photograph land surfaces and develop maps).

The student can comprehend and analyze the effects of technology on self, society, and the environment which may include:

- the effects of technology on self and society (e.g., expanding world-wide communication through the use of satellite technology); and

- the effects of technology on the environment and natural resources (e.g., harmful effects on the environment caused by the disposal of nuclear waste).

SCIENCE OBJECTIVES: GRADE EIGHT

NATURE OF SCIENCE

OBJECTIVE: The student can demonstrate a comprehension of the nature of science.

Explanation: The student can comprehend the nature of science by understanding the characteristics, generation, use, and interpretation of science knowledge. Through a variety of science experiences, the student should become aware of the constant generation, change, and impact of science knowledge and should recognize his/her own ability to contribute to and be a part of this process. More specifically, in the eighth grade, the student can learn skills such as the following.

The student can comprehend characteristics of science knowledge by understanding that:

- science knowledge is tentative in that it is subject to change as more information is obtained and is better understood (e.g., the student recognizes that some science knowledge about the universe may change or become invalid as new information is obtained from space exploration);

- science knowledge is based on data in that it depends upon observations and measurements to answer questions (e.g., in an investigation involving weather, the student recognizes that data such as barometric pressure, wind speed, and wind direction, are needed to answer questions such as "What weather conditions indicate an impending thunderstorm?"); and

- science knowledge is often represented by both conceptual and physical models which represent the best estimate of reality and can be used to understand phenomena and answer questions (e.g., the student recognizes that the rock cycle can be used as a model to explain and answer questions about the formation of and changes in rocks).

The student can comprehend that science knowledge is generated through:

- curiosity which motivates discoveries (e.g., the student recognizes that curiosity motivates scientists to investigate plate tectonics);

- combining and applying results from previous studies (e.g., the student recognizes that new knowledge about the nature of the universe is generated when scientists integrate prior knowledge with results from current investigations involving black holes); and

- repeating investigations under similar conditions and obtaining similar results, thereby, establishing the credibility of the results (e.g., through repeated investigations involving the relationships between soil type/density and erosion the student recognizes that similar results make the findings more credible).

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SCIENCE OBJECTIVES: GRADE EIGHT

NATURE OF SCIENCE (continued)

The student can comprehend how the use and interpretation of science knowledge is affected by factors such as:

- personal perspectives (e.g., the student recognizes that scientists may disagree on issues such as the use of nuclear energy because of their personal perspectives); and

- societal influences (e.g., in a discussion on nuclear wastes, the student recognizes that the disposal of nuclear wastes is affected by societal influences).